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THE QUADRUPEDS OF ARIZONA.

BY DR. ELLIOTT COUES, U. S. A.

(Continued from p. 363.)

FAMILY *Saccomyidæ*, the Pouched Rats. This is a curious and interesting family of Rodents, represented in Arizona by quite numerous species. Its several genera differ to a remarkable degree in external characters, but agree in the possession of very large cheek pouches, opening outside the small mouth, and capable of enormous extension; and in numerous anatomical features. Two subfamilies exist in North America,—the *Geomyinæ*, and the *Saccomyinæ*. The former includes the "Gophers" or "Salamanders" or "Pouched Rats," as they are variously styled in different sections. They are clumsy, thick-set animals, with large heavy heads, short thick necks, small inexpressive features, short tails, and very strong muscular legs, armed with large claws, eminently fitted for digging. They are also wholly nocturnal, and live in subterranean galleries which they excavate. The *Saccomyinæ*, on the other hand, are elegant in shape, of pleasing colors, and graceful motions; and though par-

tially subterranean and nocturnal, often come abroad in the daytime. They are known in the vernacular as "Kangaroo" or "Jumping" Rats and Mice, and are entirely confined to Transmississippian regions. The largest species is about as big as a third-grown rat, while the smallest is among the most diminutive of all our animals, unless some of the shrews are still less in size. These animals have well-formed bodies, very large and muscular thighs, small hands, large rounded ears, full protuberant eyes, and very long tails, often tufted at the end. Their fur is peculiarly soft and lustrous.

The two genera of the *Geomyinæ*, though very similar to each other, are distinguished, among other features, by the absence in *Thomomys* of the deep central longitudinal grooves in the upper incisors which exist in *Geomys*. The latter is hardly known west of the Rocky Mountains, nor the former to the eastward of them. Though two other species may occur in Arizona (*Thomomys bulbivorus* from California, and *T. umbrinus* from Sonora), only one, the Red Sand-rat (*T. fulvus*) is at all common. It was discovered by Dr. Woodhouse in the vicinity of the San Francisco Mountains, where it is exceedingly abundant. It lives mainly in light sandy or loamy soil, such as may be readily excavated. The soft soil of grassy hill-sides, or sloping meadows, especially in the vicinity of oaks, or clumps of nut-bearing trees, are favorite resorts, as it finds there an abundance of acorns, seeds, and grasses, upon which it feeds. The succulent stems and roots of many herbs also furnish it with food. Wherever it takes up its abode, little piles of fresh moist earth may be seen in every direction, sometimes scores within a radius of as many yards. These are especially noticeable in the morning, for the animal is strictly

nocturnal, never working, and rarely venturing from its burrow in the daytime. During the night it is very industrious, both in collecting food and in enlarging its galleries; and the amount of fresh earth visible one day, where none had been the day before, is sometimes astonishing. Should Arizona ever become a cultivated region, this gopher would be wellnigh as great a pest to the farmer as the *T. bulbivorus* and *Spermophilus Beecheyi* are in California. We were much annoyed by their digging around, and partially undermining our tents, causing the canvas flooring to slump in when trodden upon. Pouring water in their holes, or plugging them up with sticks, seemed to take effect mainly as a provocation to them to dig others. Though thus daily "bored"—literally and figuratively—by these beasts, I never saw one in a state of nature, and only procured two specimens in as many years. It is notorious that a person may live surrounded by them for years, and never see one, so timid and retiring are they, and so strictly nocturnal.

The Pouched Kangaroo Rat (*Dipodomys Ordii*) is the main representative of its subfamily in Arizona, and extends also over New Mexico, Texas, and part of Mexico. A closely allied species (*D. Philippii*) replaces it in California. It is one of the most abundant of the Rodents about Fort Whipple, where it more nearly takes the place of the house rat and mouse than any other native species, except an *Hesperomys*, to be presently noticed. It is beautiful in form and colors, and its motions are agile and graceful. Above, it is of a clear fawn color, deepening along the middle of the back into brownish gray; the whole under parts are pure silvery white, which color also forms an artistic contrast to the fawn, by striping the head and thighs. The long tail, tufted near the end,

is mouse-gray above and below, and pure white on its sides. The fur is peculiarly soft, smooth, and lustrous. It chiefly inhabits loose sandy soil, like a gopher, though its "sign" differs greatly from that of the last named; but it is not entirely subterranean in habit, as it may be found living in piles of brush, fallen logs, etc. Though it labors at its domicile, and collects food mainly by night, it should not be called a nocturnal animal, any more than a House Rat, though the latter is liveliest and most plaguey after dark.

Since the erection of buildings in the interior of Arizona, the Kangaroo Rat has in a measure taken up its residence about them, showing the same adaptability to semi-domestication that the House Mouse exhibits. Many used to live in our storehouses and granaries at Fort Whipple, and even brought forth their young there, in just such nooks as the common mouse would select. Parturition occurs in May or June, though more than one litter may be produced in one season. The young are for some time much darker and grayer than their parents. Although sullen, and apparently much cowed when first caught, these rats soon become familiar, and make agreeable pets. I have frequently seen them enter my tent at night, when all was still, and search about for food. They ordinarily move on all-fours, with a motion not unlike that of a rabbit when leisurely moving about. The body is alternately strongly arched and extended; the long hind feet rest on the ground to the heel, and the heavy tail trails straightly after. If frightened, this easy motion is changed to a succession of astonishingly vigorous leaps. Perhaps the most beautiful features of these animals are their eyes, which are round and full, glossy black, and softly brilliant.

Another genus of Pouched Mice (*Perognathus*) occurs in Arizona. Its species much resemble those of *Dipodomys* in general appearance. Prominent amongst them is the *P. penicillatus*, also discovered by Dr. Woodhouse on the San Francisco Mountains. It is the largest species of its genus in the United States. Two others known to occur are *P. flavus* and *P. parvus*, both of which are among the most diminutive of all our animals. Little is known of these comparatively rare animals, though it is presumed that their habits are in general similar to those of *Dipodomys*.

Family *Muridæ*, the Rats and Mice. A species of this extensive family—the *Jaculus Hudsonius*—is also called the "Kangaroo" or "Jumping" Mouse, but must not be confounded with the preceding. It belongs to the same subfamily (*Dipodinæ*) as the Jerboa (*Dipus sagitta*). It has no cheek pouches, and is otherwise conspicuously different from any member of the *Saccomyinæ*. It is of very extensive diffusion throughout North America, though I believe its actual occurrence in Arizona requires confirmation.

Exclusive of the *Dipodinæ*, the *Muridæ* are represented in North America by two subfamilies: the *Murinæ*, or true rats and mice, and the *Arvicolinæ*. The latter is composed of the Meadow-mice (*Arvicola*), the Musk-rats (*Fiber*), and the Lemmings (*Myodes*). The first subfamily is usually divided into the *Mures*, or "Old World Rats," as they are called, and really were originally, though they are now cosmopolite; and the *Sigmodontes*, or "New World Rats," embracing such forms as the Cotton Rats (*Sigmodon*), the Bush Rats (*Neotoma*), and the Field-mice (*Hesperomys*). I am not aware that any "Mures" have as yet made their way into the central and

unfrequented portions of the Territory, though the usual number of them exist at our various footholds on the Colorado River. In the interior, the indigenous species hold full sway, or at least did so two or three years ago,—the time of which I write,—though since then the Brown Rat (*Mus decumanus*), and the House Mouse (*Mus musculus*) may have migrated all over the Territory, or been transported wherever the white man has settled.

The genus *Hesperomys* is, perhaps, the best represented of the *Sigmodontes*. At least one species (*H. eremicus* Baird) is very abundant, both along the Colorado valley and the interior of the Territory. I found it very numerous at Fort Whipple, where it in a great measure seemed to abandon its primitive habits, and take up its residence as a veritable house mouse in buildings, particularly our granaries and store-rooms. It was sufficiently numerous to become quite an annoyance, sharing the plunder and comfortable home with the Kangaroo Rats. It ordinarily lives in bushes, brush-heaps, scrubby trees, etc., where it builds a somewhat bulky nest, of a globular shape, of grasses compactly matted together, and warmly lined. Another species (*H. Sonoriensis*) which I have never personally met with, occurs in the southern portions of the Territory. Mr. Clarke says that it seems to live, as circumstances may determine, either in the ground or in hollow trees. The species (or perhaps only variety of *H. leucopus*) called *H. Texensis* by Dr. Woodhouse, may also occur in South-eastern Arizona.

The genus *Reithrodon* (of which the little Harvest-mouse of the Southern States (*Reithrodon humilis*) is a typical species) is very similar to *Hesperomys*, but the upper incisors are longitudinally grooved instead of being

perfectly smooth. Those species most likely to occur are *Reithrodon montanus* Baird, of which the type is from the Rocky Mountains in latitude 39°; and *R. megalotis* in the regions contiguous to Sonora. They must either be quite rare, or of very inconspicuous habits.

The Bush Rat (*Neotoma Mexicana*) is abundant throughout the Territory, and forms no small item in the economy of the Indians. Not only the numerous tribes of the Colorado, but also the various branches of the Apaché family, make great use of them as an article of food. After the destruction of Apaché "rancherias," we always found, among other implements and utensils, numerous sticks, about as big as walking-canes, one end of which was bent in the shape of a hook, hardened in the fire, and a little sharpened. These, I was informed and have every reason to believe, were used to probe holes and poke about brush-heaps for rats, and to drag them out when discovered.

This statement may be doubted by those who know of the Bush Rat only as an arboreal species, building a compact globular nest of grasses and sticks in mezquite and other low thick trees. While this is certainly the case, there is no doubt that, under different circumstances, it may live underground, among rocks, or in brush-heaps. I have seen many heaps of rushes, sticks, and grasses, which could have been the work of no other animal, and formed either the nest itself, or the "vestibule" of a subterranean abode. I have also been informed to the same effect by several hunters and good observers. Dr. Kennerly has found it living under stones. It shows no tendency to modify its primitive habits by taking up its residence with man.

The food of these rats is entirely vegetable, and ob-

servers agree in noting their particular fondness for mezquite beans; both the long straight pods of the *Algarobia glandulosa*, and the curious spirally-twisted fruit of the "screw-mezquite" (*Strombocarpa pubescens*). As might be expected from the nature of their food, their flesh is excellent eating.

The idea of eating rats is doubtless disgusting to most persons—not Chinese nor Indian; but all such must remember that they take their notions from the House Rat, which is a dirty beast, feeding upon sewerage, garbage, and any decaying animal or excrementitious matter which may come in its way. The Bush Rat's food is as cleanly as that of a hare or squirrel, and there is no reason why its flesh should not be as good, as in truth I can assert it to be, having eaten it myself.

Arizona seems remarkably deficient in Meadow-mice (*Arvicola*). I am not aware that any species has been recorded from within its limits. At least one exists, however, as I know, having taken some fragments, too much mutilated for identification, from the stomach of a large hawk.

The Musk-rat, or Ondatra (*Fiber zibethicus*), so extensively diffused over North America, finds a place in Arizona, and is common on many of its streams. It is said that this animal and the beaver cannot live harmoniously together, the one harassing and finally dislodging the other; but I cannot vouch for the truth of the assertion.

The Indians make considerable use of Musk-rat skins for quivers, a number of them being sewn together, though a single skin of some larger animal, as a lynx, is usually preferred.—*To be concluded.*

THE AWAKENING OF THE BIRDS.

BY T. MARTIN TRIPPE.

To those who are in the custom of studying the habits of our native birds, their awakening, and early songs are very interesting. It is in the early morning that birds are in the highest spirits; then it is that they appear to the best advantage; and then it is that their songs are sweetest. When summer comes on, and the days grow hot and long, and the singing of the birds ceases nearly altogether, early in the morning, ere yet the sun has warmed the cool air, the birds sing with all their former vivacity, and seem the same merry-hearted beaux that they were in spring. The early morning has always been a favorite time of mine for studying Natural History, and especially Ornithology; and I always learn more in one hour then, than in three or four in the middle of the day.

Some birds rise much earlier than others. As a rule, those that live in the fields are much earlier risers than those dwelling in the woods; and, *per contra*, the field birds go to bed earlier than the wood birds.

The Robin is our earliest songster. While the stars still twinkle, and the first gray streaks of dawn have but just appeared, the Robin wakes from his sleep, and pours forth his matin hymn. From all sides the songs proceed, —from the orchard and garden, from the edge of the neighboring woods, and from the trees that fringe the brooks and ponds, you hear the joyous, ringing strains of this delightful songster. After singing for ten minutes or so, Robin descends from his perch, and seeks his breakfast with an appetite sharpened by the morning air; yet you hear him throughout the morning, but not so

often as in the early dusk. Then he puts forth his finest effort; and if you would fully appreciate his song, you must listen to his *matinee* which he gives in the earliest light.

While the Robin is yet singing, the two Pewees awake, and mingle their mournful notes with the Robin-concert. These notes, though so sad and plaintive, have, nevertheless, a pleasing effect; and the common Pewee especially is welcome. Long after you have ceased to hear him in the broad glare of day, or even in the quiet evening, you may listen to him in the early morning, the fresh air of which seems to have an electric effect, not only upon him, but upon all the other birds besides.

Shortly after the Robin has finished his song, or rather while he is still singing, the Bluebird is heard "saluting the morn with his soft notes." You seldom hear him during the hot summer days of June and July; but here, in the early morning, he is the same gallant and musical fellow that he was in March and April. Simultaneously with the Bluebird the Chipping Sparrow awakes, and is soon heard chanting his simple cricket-like song from the garden and lawn.

But now, as the light increases, and the clouds in the east give evidence by their crimson hues that the sun is nearing the horizon, birds of all sorts begin to awake. The sharp "*sphack*" of the Least Flycatcher comes from the orchards; the King-birds make the fields noisy with their notes, and the songs come so thick and fast, that it is next to impossible to tell which was the earliest. The Song Sparrows and the Indigo-birds sing sweetly from their accustomed haunts, while the Vesper Sparrow delivers his delightful strains from the broad open pasture-lands. This latter bird seems to take a fancy to singing

in the dusk, for, although one may hear him at all hours, still he prefers the dim morn or the quiet twilight. The Bobolink is an early riser too, and his jolly, jingling notes add much to the chorus of bird-voices that now chant so sweet a concert on every side.

The forest birds are now awake, and from the dark, distant woods come the faint bell-like notes of the Wood Thrush, our prince of songsters. The Veery, and the Rose-breasted Grosbeak join in with him, and the woods soon ring with the notes of these three birds, who are unquestionably our finest songsters. The Vireos, who have been awake some time, lend their sweet voices to swell the choir; and as the sun rises in the sky, the concert each moment grows louder and louder. The Golden-crowned Thrush begins his hurried, ecstatic song; the Wrens, Catbirds, Orioles, Warblers, and Sparrows, all add their notes to the sylvan concert; and by the time the sun has lifted himself well above the horizon, all the birds are awake and in full song.

AGENCY OF INSECTS IN FERTILIZING PLANTS.

BY W. J. BEAL.

(Concluded from page 260.)

THERE are two other peculiarities among certain plants by which a cross-fertilization is made most probable, and even very sure in some cases, notwithstanding the flowers are all perfect and of one form.

In some of these the stigmas come out and are fertilized before the anthers of the flower burst open; while in

others the anthers are in advance, and discharge their pollen before the stigmas appear. In either case the flowers act as though they were monœcious.

These peculiarities have been termed *dichogamy* by Sprengel, who made the discovery many years ago. Of the first kind, in which the stigmas are in advance of the anthers, I examined the young flowers of several species of Spiræa, just before any of the anthers had opened, and in all I found the stigmas quite plentifully covered with the yellow powder. Many stigmas were dry and withered, while some of the anthers were still full of fresh pollen. Similar observations were made upon False Solomon's Seal, several species of Potentilla, Plum, Cherry, and others. One of the best examples of this kind was pointed out by Dr. Gray, in the case of the Plantain or Ribgrass (*Plantago lanceolata* Linn.), a troublesome plant which is too rapidly finding its way into meadows and waste places.

These flowers, in arrangement, somewhat resemble a short tapering spike of Timothy or Herd's-grass. The long hairy stigmas come out first at the base of the spike, and are quite withered and dead before the stamens of the same flowers appear in sight. By the time the long thread-shaped stamens of the lowest flowers hang out their anthers, the stigmas of other flowers higher up the spike are exposed and ready to receive the fertilizing element. So new pistils continue to come forth, keeping in advance of the stamens. The long filament raises the anther so high that it is brought near the stigmas of younger flowers farther up the spike. This plant, like most of the large Grass-family, is not visited by insects, as it secretes no nectar, but each anther is hung on a mere point (versatile) and every slight motion of the air keeps it flutter-

ing. By applying a low magnifying power, the pollen was seen with its long tube thrust into the stigma before anthers had shown themselves above the calyx. While within the calyx the filaments are folded upon themselves, which accounts for their great length as soon as they come forth.

The Broad-leaved Plantain (*Plantago major* Linn.), so common about door-yards, resembles the one above mentioned as regards its mode of fertilization.

On the long spikes of flowers of the False Indigo and Lead-plant (*Amorpha fruticosa* Linn., and *A. canescens* Nuttall), the bees and wasps were seen beginning at the base on the older flowers, and so passing up, visiting those above in which the anthers were still young and enclosed by the corolla. Here, as in the Plantain, the pistils are a day or two in advance of the stamens, and the insects are a means of affecting a cross-fertilization.

The common Dandelion (*Taraxicum dens-leonis* Desfontaines) is a good example of the other kind of dichogamy, in which the anthers discharge the pollen before the stigmas are ready to receive it. This belongs to a very large family called *Compositæ*, which contains from one-eighth to one-tenth of all the flowering plants in this part of the world. Each yellow head in the Dandelion is a cluster of small flowers packed closely together, and not one large compound flower as the name implies, which was given by the early botanists. Each pistil bears two long slender stigmas surrounded by the anthers which are united by their edges, forming a tube (*syngenesious*). The stigmas are covered on the outside with small hairs, having their tips pointing upwards, like the beards on a head of barley.

Imagine a head of barley much lengthened and split in two down the middle, and you have a good representation of the stigmas of a Dandelion. When the tips of these are just above the apex of the anthers, the pollen is discharged and carried up on the hairs by the style which grows very rapidly at this time.

The stigmas are closely pressed together until clear above the anthers, when they begin to spread and roll back, exposing the inside surface which alone is sensitive to the action of the pollen. Several kinds of bees, flies, and smaller insects visit these flowers and brush the pollen off the outside of the style, and leave some on the inside surface where it can take effect. Were it intended for close, self-fertilization, as a superficial examination would seem to indicate, the style should be shorter, and the stigmas a little separated, so that pollen would meet the proper surface before the stigmas leave the surrounding anthers. Or else the surface, which is sensitive to pollen, should be on the outside instead of on the inside.

I have examined Coreopsis, Fall Dandelion (*Leontodon*), and Succory, and many more of this vast family, which showed these same peculiarities mentioned above.

In Sweet Coltsfoot (*Nardosmia*), a rare plant of this order growing north of this latitude, some of the little flowers are sterile, i. e., the imperfect pistil bears no seed, but the top of the style has a tuft of little hairs which push up the pollen from the anther-tube that it may reach the stigmas of other flowers, and so not be entirely lost.

At the suggestion of Dr. Gray I examined some half a dozen or more species of Bellflower, or Campanula. The one most carefully noticed was *Campanula rapunculoides*.

It has five anthers which stand up close together, although not joined by their edges into a tube as in the dandelion. In three other respects it resembles this plant; namely, in having the style covered with hairs or short bristles on the outside, and in having the sensitive part of the stigma on the inside. In the same way also the style nearly doubles in length after the pollen is discharged.

The pollen begins to discharge very soon, so that by the time the corolla is fairly open, the anthers wither, and are coiled up at the base of the flower. After the hairs on the style have nearly all disappeared, and the pollen which they held has been removed, or has turned brown in decay, the stigmas separate at the top, and expose the sensitive surface. For each flower to be self-fertilizing, this plan is a perfect failure.

Bees are willing agents here, as in other instances, alighting first on the stigmas of the oldest flowers, which are farthest down the stem, and then passing up to others which are younger. Besides collecting nectar at the bottom of the flower, they collect the pollen by scraping the style upon each side with their legs, and, when calling at the next flower, first strike the exposed stigmas, leaving a few little morsels as tribute for their bountiful supply.

The flowers of the Mallow Family have numerous stamens, joined into a column or tube (*monadelphous*), through which the stigmas are protruded. My observations on this family have been rather limited, but in the High Mallow (*Malva sylvestris* Linn.), the anthers all burst, and very little pollen remains about the flower, when the stigmas first come to the light, as brides too late for the marriage, for the bridegrooms have been carried away by the priests, and perhaps wedded to others.

The fact once well established, that insects are necessary to fertilize plants, brings up some other interesting inquiries in reference to the origin of animals and plants. Some would probably say that plants, which now require the agency of insects, have arrived at their present form by a long series of gradual changes, and that before the proper insects were created they were capable of self-fertilization. Others may say that the plants of this structure were created later than those capable of self-propagation, and upon which the insects could subsist for a time. Another plan can, however, be devised, as they are alike useful to each other. "As the bow unto the cord is," they may have been called into existence at the same time, the flowers to secrete nectar for the insects, and the insects to fertilize the flowers.

Were Dr. Watts again alive, and should some one tell him these facts of science, he might well exclaim, as the Queen of Sheba did to King Solomon, "Behold the half was not told me." He gave us but half the story, and that the one which teaches the least instructive lesson. It is now over two years since some one, I wish I knew his name, rung the change,—

> "How doth the little busy bee,
> Improve each shining hour,
> By carrying pollen day by day,
> To fertilize each flower."

The bees go buzzing through the air visiting flower after flower, not only to get their daily bread, but render an essential aid in perpetuating the existence of the very same plants which furnish them food.

This furnishes another pertinent illustration of the mutual dependence of the animal and vegetable kingdoms.

THE TARANTULA.

BY G. LINCECUM, M. D.

This very large hunter-spider makes its appearance in Texas some years as early as the twenty-fifth of May, generally, however, not earlier than the first days of June. They dwell in the ground in a hole, which they excavate themselves, about one inch in diameter, and six or eight inches deep, widening a little at the bottom. They make their nocturnal hunting excursions for some distance from the hole, returning to it early in the morning, and are occasionally seen walking out of evenings, and also in cloudy days. They would probably hunt their prey altogether by daylight, were it not for their dread of the great *Pompilus formosus*, or Tarantula Killer, their natural enemy. Towards sunset, about the first of June, the *Mygale Hentzii*, or Tarantula, is often seen creeping along the narrow paths in the grassy woods, or in the prairies, searching for some kind of small game,—worms, grasshoppers, small lizards, anything they can kill, upon which they leap with great violence and wonderful agility. I discovered one of their holes several years ago in my garden, and, looking into it, could see the eyes of the Tarantula glittering like coals of fire. I procured a large fat grub, and holding it near the mouth of the hole, the Tarantula instantly rushed out, and seized the grub with such violence as to startle me. I fed it daily for two weeks, and it consumed two large grubs each day. It became quite tame and much more decent in taking its meals from my hands.

On going into the garden one evening, I met our large red-winged Pompilus—it was also one of our pets, parad-

ing about the house and yard—dragging my murdered Tarantula, which was as limber as a rag, out through the gate. She dragged the paralyzed victim to the dwelling-house, distant about fifty yards, and entombed it in her great cemetery under the floor, where she had already deposited many of its kindred.

I have been observing this spider as closely, considering its nocturnal habits, as I could during the last twenty years. I have seen no nests, no webs, no eggs, nothing but a roughly-made hole seven or eight inches deep, carried down not quite perpendicularly, and widened a little at the bottom. I have examined many of these holes, and, except an occasional dead grasshopper, saw nothing in them that suggested the idea of a nest. These holes seem to be fortifications only, to protect them while they sleep from the incursions of their diurnal enemies.

I have seen their young many times, always sticking among their stiff hairs, and clinging to their legs and body; but where these young ones come from I am not prepared to explain, nor can I with my present experience say, whether the Mygale Hentzii is viviparous or oviparous. Its habit is to carry its young on its back until they are large enough to capture small insects for themselves, when it turns them off in some good hunting-ground in such numbers that they would soon, if they could all come to maturity, monopolize the entire privileges of spiders on this little green globe.

Some of the ground spiders carry their eggs in a sack attached to the tip of their abdomen. One species makes nests with a trap-door to them. They are rare in this country. I have never seen any such contrivances about the hole of the Tarantula, nor have I ever seen it carrying an egg-sack. It may be possible that they keep such a

sack at the bottom of their hole, and, when the young hatch out, take them on their back and carry them about, as I have often seen them. I have, however, never discovered any such egg-sack, though I dug out many of their holes. It may be that I did not dig them up at the proper time to find their eggs. They are too filthy when confined, or I would send you a live one.

Two or three species of Mygale carry a sack well filled with eggs, attached to the tip of their abdomen; and when the young ones hatch out, they take them on their backs and carry them like the Mygale Hentzii. There is one species of the family that constructs an exceedingly curious gossamer nest in a hole in the ground. It first digs the hole about six inches deep, and then lines it thickly to the bottom with a very fine white web, finishing it with a cunningly wrought and very neatly fitting trap-door, having hinges and a string to fasten it on the inside. This type of spiders is very rare in Middle Texas.

THE LAND SNAILS OF NEW ENGLAND.

BY EDWARD S. MORSE.

(Continued from page 315.)

We continue our descriptions of New England Land Snails, with a species very common in certain portions of the West and South, though of very rare occurrence in New England.

Helix suppressa *Say*. (Fig. 25.) Shell thin and pellucid; yellowish horn-color, polished; spire flat. Whorls six, closely revolving; suture distinct; lip simple, thickened within. Base of shell rather convex; near the aperture

Fig 25.

opaque, and yellowish white. Umbilicus absent, or hardly apparent in adult specimens. Within the aperture on the outer lip are one or two long thin teeth. Diameter of shell about one-fourth of an inch. Animal bluish black, upper tentacles long and delicate. A minute slit on the extremity of the body exudes mucus freely when the snail is crawling.

This species can at once be distinguished from all the others to be described, by the peculiar teeth in the aperture. Common in the Middle States and Ohio. It has been found in the extreme western part of Connecticut. Mr. W. G. Binney states that he has generally found them in open fields at the roots of grass, and not under decaying stumps and rotten bark.

HELIX CONCAVA *Say*. (Figs. 26, 27.) Shell depressed, whitish horn-color. Whorls five, flattened above, rounded below; suture very distinct. Umbilicus wide and deep, revealing all the volutions to the apex. Aperture rounded, slightly flattened above. Usual diameter one-half an inch. Animal grayish, disk dusty white, with reddish discolorations. Found in nearly every State in the Union; quite rare in New England.

Figs. 26, 27.

This species is peculiar in its habits. It lives in the dark woods, and is a regular cannibal in its propensities. Its body is long, slender, and worm-like. Its jaw has a sharp projecting point to cut and tear its prey, and the teeth on the tongue are unusually long and pointed, and well adapted to subserve its rapacity. It lives on the flesh of other snails. With its long and slender body, it insinuates its head into the aperture of the shell, the inmate of which it is about to devour. The victim with-

draws far within the shell, but in vain. Its enemy slowly approaches, and the hapless victim having no barrier to interpose, nor any line of retreat open, is actually devoured bit by bit. We remember collecting a lot of rare snails in the backwoods of Maine. Wishing to study them, they were unsuspectingly placed in a box of moist earth containing a few specimens of our cannibal snail. Imagine our astonishment and indignation on examining the box a few days after, and finding our special rarities completely destroyed, only a few empty shells remaining as tokens of the cannibal feast. We could almost see the murderers smacking their slimy chops and begging for more.

Other species are known which possess this desire for animal food, and the collector in France oftentimes secures a goodly number of specimens by placing a piece of fresh meat in the woods, the odor of the meat attracting certain species; for snails apparently possess, in a considerable degree, the faculty of smell, and will, with nice discrimination, select from a parcel of leaves those most succulent and agreeable.

HELIX INDENTATA *Say*. (Fig. 28.) Shell flattened, thin, pellucid, highly polished, whitish, sometimes pinkish. Whorls four, rapidly enlarging, with regular impressed lines radiating from the suture, reaching nearly to the base of the shell. Lip simple, extending to the centre of the shell at its base. Umbilicus absent, though its region is indented. Diameter of shell nearly one-fifth of an inch. Animal bluish black. Inhabits deep woods in the Northern, Middle, and Western States. This beautiful species is not common. It can readily be distinguished from allied species by its closed umbilicus.

Fig. 28.

We refer our readers to the early papers on this subject in this Magazine, where an explanation of the terms used in these descriptions may be found.

The brevity of these papers is owing to their being intended principally for those who are making, or wish to make collections in this entertaining branch of natural history, and are offered as guides to them. Hopes are entertained that others may be led to form collections, from the brief hints thrown out respecting the hiding-places of these almost obscure animals. Many who spend their leisure time in solving illustrated riddles, and derive, as the result of their labor, simply an answer, would find that the expenditure of half the brain-work, if applied to the identification of the fruits of a day's ramble in the woods, would furnish not only a healthier intellectual enjoyment, but, with proper training, lead to an endless pleasure in the contemplation of the boundless wealth of creation.

St. Augustine has truthfully written that "every species of animal has beauties peculiar to itself. The more man considers them, the more they engage him to adore the Author of Nature, who has made everything in wisdom, who has subjected everything to His power, and whose goodness governs the whole."

THE HAND AS AN UNRULY MEMBER.

BY BURT G. WILDER, M. D.

Natural History is not now the simple thing it was a century ago. Leaving out of view the two great departments of Botany and Mineralogy, it then consisted of a

Fig. 1.

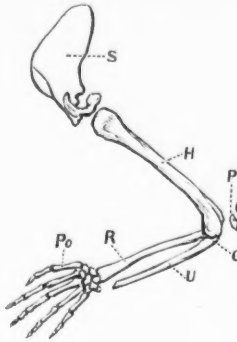


Fig. 2.

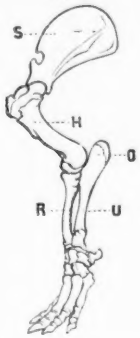


Fig. 3.

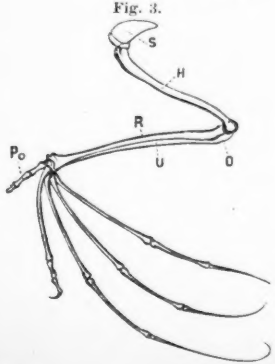


Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

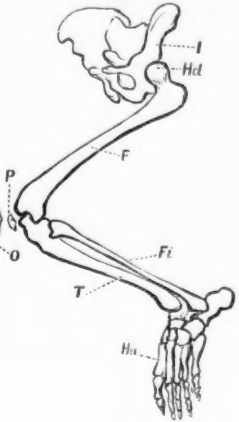


Fig. 8.

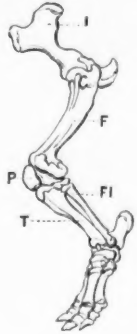


Fig. 9.

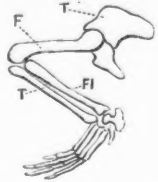


Fig. 10.

limited and superficial acquaintance with the habits and external appearance of the few known animals; how few these were, as compared with those we now know, may be seen from this, that, in 1748, Linnæus enumerated *two hundred and eighty* different kinds of fish; at the present time, the Museum of Comparative Zoölogy at Cambridge, Mass., contains over *nine thousand* species of that class, about *twenty-two hundred* of which were collected in the late Thayer Expedition to Brazil.

So impossible is it for any one person to gain a thorough knowledge of all animals, that we find men devoting years, their lives almost, to the study of a single species;* while it is daily becoming more and more apparent, that in order to advance or even to keep up in modern science, each must devote himself principally to a few branches of Natural History.

To show how far this division of labor has already extended, take the single department of Comparative Anatomy, which embraces the following lines of study: 1. The anatomy of a single species considered by itself; as Anthropotomy, or human anatomy; Hippotomy, the anatomy of the horse, etc. When this kind of study is extended to the microscopic investigation of the structure of *tissues*, it is called Histology. 2. One or more species may be traced in their development and growth from their beginning as an egg to the adult condition, —this is Embryology. 3. We may enlarge our conception of the plan of creation, by comparing with the animals which now live the fossil remains of those which

*For instance, the "Anatomie descriptive et comparative du Chat," by Straus-Durckheim, 1845, comprising two quarto volumes of text and a large folio atlas of plates, yet treating of only the bones, the ligaments, and the muscles. Also, the "Traité de la Chenille qui ronge le Bois de Saule" (larva of the goat-moth, or Cossus ligniperda), by Pierre Lyonnet, 1760; a quarto volume of 615 pages and eighteen plates.

existed in past ages, this constituting the science of Palæontology. 4. Then comes Physiological Anatomy, which treats of organs in reference to their *functions;* and, lastly, there is what is called Homology, in which parts and organs are considered, not according to their *size*, or *shape*, or the specific functions which they perform, since these vary greatly in different species, but according to their *essential structure* and their *connections with other parts;* these last are called *morphological* characters, and they alone are sufficiently constant to serve as the basis of zoölogical classification. This branch of anatomy is generally followed with a view of determining and comparing corresponding or homologous organs in *different animals*, but the same methods may be employed in another way, which has been in existence for hardly a century, and for which no name has yet been fully accepted; it consists in the *determination and comparison of corresponding parts in different regions of the same individual.*

To illustrate the distinction between these two kinds of Homology, by reference to familiar objects, the former would compare the foremast of one ship with that of another, and note their difference in the size and proportion of the various pieces; while the latter would compare the foremast with the mainmast of the same ship, pointing out their resemblance, and the differences in the length of the various pieces.

It is to this latter kind of anatomy that I propose to call attention, and have chosen for a subject an organ which, though small, is most comprehensive, gathering within its grasp far more than can be illustrated in this short article,—the Hand.

It is a time-honored theme, and he stands in great dan-

ger of repetition who takes for his subject a part of our corporeal frame, concerning which there has been written by men of science, preached by divines, and even sung by poets, more than of any other organ, excepting, perhaps, the eye. He would indeed be most presuming who should, without the reputation and consciousness of most profound knowledge, undertake to more than express his concurrence in what has been already said concerning the beauty of form, the complexity of structure, the marvellous skill, and the wonderful diversity of function which characterize the human hand.

There is, however, a view of the subject to which little attention has been paid by those who have treated it, but a correct idea of which is really essential to the fullest appreciation of the wonders so eloquently set forth by Sir Charles Bell,* and by anatomists generally,—a view in which the human hand, while furnishing to the student of *final causes*, to the *teleologist*, his most perfect illustration of the adaptation of means to desired ends, becomes to the *morphologist*, to the student of *unity of type* under diversity of form and function, a fruitful source of anxiety, and even, as will be seen, of serious error.

So widely spread and so deeply rooted is this error, and so almost wholly is it due to the peculiar structure and endowments of the hand, that we are justified in drawing a comparison between it and that other organ whereof the Apostle wrote,—"Even so the tongue is a little member. . . . . It is an unruly evil, full of deadly poison."

Now it is evident that by *tongue* in this connection is by no means indicated the mere anatomical organ which all vertebrates carry in the floor of the mouth, composed of certain muscles, supported by certain bones, and sup-

*In his admirable Bridgewater Treatise on the Hand.

plied with nerves of motion and of sensation. We are indeed right in applying the *name* tongue to the fleshy pad in the mouth of the fish, to the prehensile fly-catcher of the chameleon, to the barbed harpoon of the woodpecker, and the glutinous snare of the ant-eater, thus recognizing in a cold, scientific way, their anatomical or *morphological* identity with the corresponding organ in the human body. But this last alone is used as a synonym for language; it alone is the facile medium of ideas, as well as of sensations; it alone has entered the service of an immortal soul, and is characteristic of man.

So with the hand. We recognize the same bones which form our upper limb (Fig. 1) in the foreleg of the quadruped (Fig. 2), in the wing of the bird and of the bat (Fig. 3), in the flipper of the seal (Fig. 4), and still more strikingly in the so-called *arm* of the ape (Fig. 5); and though the forefoot of the bear is merely a *paw* when supporting his ungainly bulk upon the earth, yet when it is flourished in the air as he sits erect upon his haunches, we are glad to escape the blow of what is then admitted to be a tolerable imitation of a hand.* And yet it is not really such; for if the presence of a thumb, capable of being opposed to the tips of any or all the fingers, is the distinguishing feature of a hand, we shall look for it in vain throughout the whole animal kingdom below man; for even in the gorilla the first digit, though strong, is short, and reaches only to the knuckle of the forefinger (Fig. 6), while in many of the lower monkies it is altogether wanting, and when present in quadrupeds is so intimately connected with the other digits as to have no independent motion.

We may assume, then, that the tongue and the hand,

*As in Pliny, 8. 36. 54.

not in the anatomical or morphological, but in the functional or teleological sense, are the really characteristic organs of man, corresponding with his peculiar endowments of rationality in thought, and freedom in action; and so it is not a little significant that to these same organs alone, which, being the most capable of good, are, by perversion, the most potent for evil, can the term *unruly* properly be applied. For they are, either singly or together, the chief ground of discussion as to "man's place in nature," showing him to be a most unruly member of the animal kingdom; they are the agents of the individual in becoming an unruly member of society, and they are, or represent, those regions of the body whose relations to other parts have ever caused the greatest trouble among the students of Philosophical Anatomy.*

Leaving to the zoölogist, the moralist, and the historian, the consideration of their respective claims to the "bad preëminence," and confining our attention to one of them, it may also be said that not only is the hand, as a whole, the main element in the discussion to which I have referred, but that the very heat and fierceness of the strife has always centred upon the most characteristic part of this characteristic organ of humanity,—the thumb.

But it is asked, What is this terrible discussion all about, and what is the matter with our hands, and especially with our thumbs?

In brief, a careful study of the anterior limbs of vertebrate animals having shown that all are built upon one general plan, but varied in form and proportion to suit

*See the various and diverse theories of the skull, especially the antagonistic ones of Owen, "On the Archetype and Homologies of the Vertebrate Skeleton;" Report of the British Association for 1846; and Huxley, "Elements of Comparative Anatomy."

the special needs of man, of the beast, the bird, and the reptile, and a like survey of the posterior limbs having shown the same to be the case with them (Figs. 7, 8, 9), so that they all present different degrees of homology or morphological relationship, our anatomical pioneers have conceived that a *similar correspondence prevails between the anterior and posterior limbs themselves;* so that not only is the shoulder, at one end of the body, merely a repetition of the pelvis at the other, but the arm as far as the elbow is seen in the thigh with the knee, the forearm in the leg, the wrist in the ankle-joint, and the hand, alas, in the foot,—"Pes altera manus."*

But here, *in extremitatum extremis*, humanity rebels. Science has gone far enough in proving that, for purposes of rational comparison and anatomical inquiry, man must assume a horizontal position on all-fours like a beast, so that his arms and legs become mere "anterior and posterior extremities;" after which degradation he can indeed arise and resume the attitude proper to the lord of creation. But to his upper and nobler parts this last comparison is most odious. They entreat us with clasped hands, they threaten us with clenched fist; they would flee from the threatened contamination; they would sit in sullen scorn at the degrading fellowship: but neither active or passive resistance is possible without the aid of the despised member, and so by slow degrees it is granted that the *ilium* (Fig. 7 I) does look very like a *scapula* (Fig. 1 S); that the *femur*, or thigh-bone (F), bears a wonderful resemblance to the *humerus*, or bone of the arm (H); that the knee-pan (P) is quite as exposed a part as the elbow; and that, perhaps, the taper forearm is only a

*These are the closing words of the first treatise upon this subject,—a paper by Felix Vicq d'Aryr. Œuvres recuilles par Moreau, 1805, Vol. IV. p. 37. Mems. de la Academie Royale des Sciences, 1794.

better view of the "calf" of the leg; but as for admitting between the hand,—

> "Her hand,
> In whose comparison all white are ink,
> Writing their own reproach; to whose soft seizure
> The cygnet's down is harsh, and spirit of sense
> Hard as the palm of ploughman,"—

any equality whatever with the foot, which is so ugly that here, as well as at the antipodes, the bootmaker's skill and our own endurance are taxed to their utmost to force it into proper shape; this is too much, and not to be allowed.

And here it may be added that the foot presents, in this respect, a contrast with the hand, not only physical, but, as it were, metaphysical; for it is plain, honest, and inoffensive, and, though much abused, shows no disposition to become an unruly member. In ancient times, indeed, warriors did cut off the great toes as well as the thumbs of their captives, but the toes are the only part of the body thrown into disuse by modern civilization, while the fingers are cherished and exalted to the highest degree. The foot is the hand's poor relation, and, though not ambitious to share its high offices which nevertheless it has often shown itself capable of discharging to an astonishing degree, yet claims, and justly too, its right in the family name.

But no; the haughty hand heeds not the humble foot, and at length, with the single warning, that, in case any remote cousinship is proved between them, the thumb has sworn to admit into his society only the great toe, which, like himself, has but two joints, and in the ape (Fig. 10) does bear him some slight resemblance, distressed humanity resigns the whole affair to the comparative anatomist. And now, after a hundred years of controversy,

comparative anatomy presents her report, admitting with shame, that, in spite of their meagre number, scarce two of her votaries can agree upon any one point, and that only two or three have ventured to disregard the above-mentioned threat on the part of the thumb. It will be seen, however, that while thus heeding the wish of that powerful constituent of the more aristocratic member, there has been a general though tacit recognition of the good conduct and sobriety displayed by its humbler representative, so that, with one notable exception,* the lower limb has been left unmolested, while the more pretentious arm has suffered all the pangs of dislocation, misplacement, twisting, and compound fracture, as the consequence of the thumb's stubborn pride.

A brief sketch of such portions of the controversy as best illustrate the unruly character of the hand, it is my purpose to lay before the reader in succeeding articles.

EXPLANATION OF FIGURES ON PLATE II.

In all the figures, S denotes the *Scapula*, or shoulder-blade; I. the shin or chief bone of the pelvis; H, the *Humerus*, or bone of the upper arm; F, the *Femur*, or thigh bone, the corresponding bone of the leg; O, the *Olecranon process*, which forms the tip of the elbow; P, the *Patella*, or knee-pan; U, the *Ulna*, or inner bone of the forearm; T, the *Tibia*, or inner bone of the leg; R, the *Radius*, or outer bone of the forearm, which supports the thumb when there is one; and Fi, the *Fibula*, or outer bone of the leg. The hand and foot are easily distinguished in all the limbs; but Po, indicates the *Pollex*, or thumb, and Ha, the *Hallex*, or great toe.

Fig. 1. Arm of Man, as it is when we get down upon "all-fours."

Fig. 2. Foreleg of Tapir; it has no thumb, and is, of course, much thicker and stronger, but otherwise corresponds quite closely with the human arm.

Fig. 3. Wing of the Bat. The scapula is very small, but the other

*In which both thumb and great toe are considered too large, and are split in twain, so as to correspond, the one to the two lesser toes, and the other to the two lesser fingers.

bones, especially the fingers, are very long and slender, to support the thin web.

Fig. 4. Foreleg or "flipper" of Seal; the bones are in great contrast with the last, but the same parts are represented.

Fig. 5. Arm of a Monkey, which has no thumb.

Fig. 6. Hand of the Gorilla; the thumb smaller than in man.

Fig. 7. Leg of Man.

Fig. 8. Hind leg of Tapir.

Fig. 9. Hind leg of Alligator.

In these three figures it is easy to trace the corresponding bones, as in Figs. 1, 2, 3, and 4.

Fig. 10. Foot of Gorilla; the great toe very large, and standing off from the others like a thumb.

By comparing Figs. 1, 2, and 4, with Figs. 7, 8, and 9, one can hardly fail to see that not only are there corresponding segments in the fore and hind limb, but also that, except in case of the hand and foot, these corresponding segments point in *opposite directions*, so that the three figures on one side are, to those on the other, as three right arms to three left arms; they are *symmetrical*.

THE CLOTHES-MOTH.

BY A. S. PACKARD, JR., M. D.

For over a fortnight we once enjoyed the company of the caterpillar of a common Clothes-moth. It is a little pale, delicate worm (Fig. 1), about the size of a darning needle, not half an inch long, with a pale horn-colored head, the ring next the head being of the same color, and has sixteen feet, the first six of them well developed and constantly in use to draw the slender body in and out of its case. Its head is armed with a formidable pair of jaws, with which, like a scythe, it mows its way through thick and thin.

Fig. 3. Fig. 2. Fig. 1.

But the case is the most remarkable feature in the history of this caterpillar. Hardly has the helpless, tiny worm broken the egg, previously laid in some old garment of fur, or wool, or perhaps in the hair-cloth of a sofa, when it proceeds to make a shelter by cutting the woolly fibres or soft hairs up into bits, which it places at each end in successive layers, and, joining them together by silken threads, constructs a cylindrical tube (Fig. 2) of thick, warm felt, lined within with the finest silk the tiny worm can spin. The case is hardly round, but flattened slightly in the middle, and contracted a little just before each end, both of which are always kept open. The case before us is of a stone-gray color, with a black stripe along the middle, and with rings of the same color round each opening. Had the caterpillar fed on blue or yellow cloth, the case would, of course, have been of those colors. Other cases, made by larvæ which had been eating "cotton wool," were quite irregular in form, and covered loosely with bits of cotton thread, which the little tailor had not trimmed off.

Days go by. A vigorous course of dieting on its feast of wool has given stature to our hero. His case has grown uncomfortably small. Shall he leave it and make another?—No housewife is more prudent and saving. Out come those scissor-jaws, and, lo! a fearful rent along each side of one end of the case. Two wedge-shaped patches mend the breach,—caterpillar retires for a moment; reappears at the other end; scissors once more pulled out; two rents to be filled up by two more patches or gores, and our caterpillar once more breathes freer, laughs and grows fat upon horse hair and lamb's wool. In this way he enlarges his case till he stops growing.

Our caterpillar seeming to be full-grown, and hence out

of employment, we cut the end of his case half off. Two or three days after, he had mended it from the inside, drawing the two edges together by silken threads, and, though he had not touched the outside, yet so neatly were the two parts joined together that we had to search for some time, with a lens, to find the scar.

To keep our friend busy during the cold, cheerless weather, for it was in mid-winter, we next cut a third of the case off entirely. Nothing daunted, the little fellow bustled about, drew in a mass of the woolly fibres, filling up the whole mouth of his den, and began to build on afresh, and from the inside, so that the new-made portion was smaller than the rest of the case. The creature worked very slowly, and the addition was left in a rough, unfinished state.

We could easily spare these voracious little worms hairs enough to serve as food, and to afford material for the construction of their paltry cases; but that restless spirit that ever urges on all beings endowed with life and the power of motion, never forsakes the young Clothes-moth for a moment. He will not be forced to drag his heavy case over rough hairs and furzy wool, hence he cuts his way through with those keen jaws. Thus, the more he travels, the more mischief he does.

After taking his fill of this sort of life he changes to a pupa (Fig. 3), and soon appears as one of those delicate, tiny, but richly variegated moths that fly in such numbers from early in the spring until the fall.

Very many do not recognize these moths in their perfect stage, so small are they, and vent their wrath on those great millers that fly around lamps in warm summer evenings. It need scarcely be said that these large millers are utterly guiltless of any attempts upon our

wardrobes, they expend their attacks in a more open form on our gardens and orchards.

We will give a more careful description of the Clothes-moth which was found in its different stages June 12th in a mass of cotton-wool. The larva is white, with a tolerably plump body, which tapers slightly towards the tail, while the head is much of the color of gum-copal. The rings of the body are thickened above, especially on the thoracic ones, by two transverse thickened folds. It is one-fifth of an inch long.

The body of the chrysalis, or pupa, is considerably curved, with the head smooth and rounded. The long antennæ, together with the hind legs, which are folded along the breast, reach to the tip of the hind body, on the upper surface of each ring of which is a short transverse row of minute spines, which aid the chrysalis in moving towards the mouth of its case, just before the moth appears. At first the chrysalis is whitish, but just before the exclusion of the moth becomes of the color of varnish.

When about to cast its pupa-skin, the skin splits open on the back, and the perfect insect glides out. The act is so quickly over with, that the observer has to look sharp to observe the different steps in the operation.

Our common Clothes-moth, *Tinea flavifrontella* (Fig. 4), is of an uniform light-buff color, with a silky iridescent lustre, the hind wings and abdomen being a little paler. The head is thickly tufted with hairs and is a little tawny, and the upper side of the densely hirsute feelers (*palpi*) is dusky. The wings are long and narrow, with the most beautiful and delicate long silken fringe, which increases in length towards the base of the wing.


Fig. 4.

They begin to fly in May, and last all through the sea-

son, fluttering with a noiseless, stealthy flight in our apartments, and laying their eggs in our woollens.

There are several allied species which have much the same habits, except that they do not all construct cases, but eat carpets, clothing, articles of food, grain, etc., and objects of natural history.

Successive broods of the Clothes-moth appear through the summer. In the autumn they cease eating, retire within their cases, and early in spring assume the chrysalis state.

Careful housewives are not much afflicted with these pests. The slovenly and thriftless are overrun with them. Early in June woollens and furs should be carefully dusted, shaken, and beaten. Dr. T. W. Harris states that "powdered black pepper, strewed under the edge of carpets, is said to repel moths. Sheets of paper sprinkled with spirits of turpentine, camphor in coarse powder, leaves of tobacco, or shavings of Russia leather, should be placed among the clothes when they are laid aside for the summer; and furs and other small articles can be kept by being sewed in bags with bits of camphor wood, red cedar, or of Spanish cedar; while the cloth lining of carriages can be secured forever from the attacks of moths by being washed or sponged on both sides with a solution of the corrosive sublimate of mercury in alcohol, made just strong enough not to leave a white stain on a black feather." The moths can be most readily killed by pouring benzine among them, though its use must be much restricted from the disagreeable odor which remains. The recent experiments made with *Carbolic acid*, however, convinces us that this will soon take the place of all other substances as a preventive and destroyer of noxious insects.

REVIEWS.

THE DEVELOPMENT OF CHLOEÖN (*Ephemera*) DIMIDIATUM. By *Sir John Lubbock*. Parts I. II. From the Transactions of the Linnæan Society, London. Vol. XXV 4to, 1866.

One of the most interesting discoveries in entomology is the fact that the May-fly, or Shad-fly, during its development from the time of leaving the egg up to maturity, moults its skin nineteen times before leaving the water, and once afterwards on arriving at the winged state.

All the books teach that there are three distinct states of the insect's life after hatching from the egg, namely, the larva, pupa, and imago; but there are many species belonging to different suborders of the six-footed insects, in which these stages graduate almost insensibly into each other. The terms larva and pupa are but relative, and not fixed and absolute. In the beetle or butterfly, the grub or caterpillar certainly seems very distinct from the chrysalis. But we have in the collection of the Essex Institute a series illustrating the transformations of the caterpillar into the pupa or chrysalis, which show several successive changes of form most remarkable and interesting to the student. There is also a gradual change of form from the pupa to the imago or perfect state, which most observers have not noticed.

The writer has shown* that the Humble-bee, before reaching the winged state, moults at least ten times, and probably a greater number. The bee-state is reached by a very gradual change of form. The newly hatched larva differs but slightly in appearance from the mature embryo just before hatching. The worm-like larva merges gradually into the pupa. Scarcely does the larva stop eating and gain its full size, when, on removing the loosening skin, the tegument of the half-formed pupa can be detected beneath, with the rudiments of the mouth-parts, antennæ, and wings, together with the ovipositor, which have begun to assume the shape of the same parts in the mature bee. They are, however, rudely shaped and but partially formed. So also the pupa merges into the bee state by insensible gradations, so that it is almost impossible to say absolutely which is pupa and which imago, from the inspection of specimens before us. Thus metamorphosis is but a growth and evolution of parts, intensified, so to speak, at certain intervals to adapt it to certain modes or conditions of life. In those

*Observations on the Development and Position of the Hymenoptera, with notes on the Morphology of Insects. By A. S. Packard, jr. From the Proceedings of the Boston Society of Natural History. 1867, 8vo.

insects which are active in the preparatory stages, and have the same habits in maturity as in the larva and pupa stage, such as the grasshopper and its allies, the changes are slow, and the metamorphosis slightly marked. In the butterfly and bee, however, whose life is so distinct in the perfect state, from the caterpillar or grub, the changes are rapid, though gradual, and strongly marked. They are not perhaps due so much to immediate physical agencies, as to the plan of life originally marked out for the insect by the creative mind.

In the present state of science we would prefer to think that structure is *correlated* to the mode of life, rather than that it is dependent on physical agencies. We feel scarcely prepared to believe with our author that the "actual form" of the caterpillar "is mainly due to the influence of the conditions in which it lives."*

We must look deeper than the agency of physical causes in the production of the various forms of life. In endeavoring to solve the problem of life and its manifestations, man may advance in knowledge without actually grasping the truth.

The theories now in vogue, suggested by Lamarck or Darwin, or as modified by other naturalists, though so stimulating to scientific thought, are yet not satisfactory, and do not go to the bottom of the matter. We must still wait patiently, and meanwhile observe, experiment, and reflect, and thus continue to question nature until she yields a willing reply.

We extract the following interesting remarks on the metamorphoses of insects, with the author's general conclusions:—

> The larvæ of insects are generally regarded as being nothing more than immature states, as stages in the development of the egg into the imago; and this might more especially appear to be the case with those insects in which the larvæ offer a general resemblance in form and structure (excepting of course so far as relates to the wings) to the perfect insects. Nevertheless, we see that this would be a very incomplete view of the case. The larva and pupa undergo changes which have no relation to the form which they will ultimately assume. With a general tendency, as regards size and the production of wings, to this goal, there are combined other changes bearing reference only to their existing wants and condition.
>
> Nor is there in this, I think, anything which need surprise us. External circumstances act on the insect in its preparatory states as well as in its perfect condition. Those who believe that animals are susceptible of great, though gradual, change through the influence of external conditions, whether acting, as Mr. Darwin has suggested, through natural selection, or in any other manner, will see no reason why these changes should be confined to the mature animal. And it is evident that creatures which, like the majority of insects, live during different periods of their existence in very different circumstances, may undergo considerable changes in their larval organization, in consequence of forces acting on their larval condition, not, indeed, without affecting, but certainly without affecting, to any corresponding extent, their ultimate form.
>
> We may now pass to the second part of the subject,—that is to say, the apparently sud-

* "The caterpillar owes its difference from the butterfly to the early stage at which it leaves the egg; but its actual form is mainly due to the influence of the condition in which it lives." Part II. p. 112.

den and abrupt nature of the changes which insects undergo. I say "apparently," because the changes in the internal organs, though rapid, are in reality gradual; and even as regards the external form, though the metamorphosis may take only a few minutes, this is but the change of outer skin—the drawing away, as it were, of the curtain; and the new form which then appears has been in preparation for days or, perhaps, weeks before.

Swammerdam, indeed, supposed (and his view was adopted by Kirby and Spence) that the larva contained within itself "the germ of the future butterfly, enclosed in what will be the case of the pupa, which is itself included in the three or more skins, one over the other, that will successively cover the larva." This is entirely a mistake; but it *is* true that, if you examine a larva shortly before it becomes a pupa, you will find that the skin is loose, and that within it the future pupa may be traced. In the same manner, if you examine a pupa which is about to disclose the butterfly, you will find the future insect, soft indeed and imperfect, but still easily recognizable, lying more or less loosely within the pupa-skin. More than one such inner skin, however, is never present.

One fundamental difference between an insect and a vertebrate animal is, that whereas in the latter, as for instance in ourselves, the muscles are attached to an internal bony skeleton, in insects no such skeleton exists. They have no bones, and their muscles are attached to the skin. Hence the necessity for the hard and horny dermal investment of insects, so different from the softness and suppleness of our own skin.

Moreover the result is, that without a change of skin a change of form is impossible. The chitine, or horny substance, forming the outside of an insect, is formed by a layer of cells lying beneath it, and, once formed, cannot be altered. From this it follows, that every change of form is necessarily accompanied by a change of skin.

In some cases, as for instance in *Chloeon*, each change of skin is accompanied by a small change of form, and thus the perfect insect is more or less gradually evolved. In others, as for instance in Caterpillars, several changes of skin take place without any alteration of form, and the change, instead of being spread over many, is confined to the last two moults.

Very little consideration will afford us an explanation of this difference. The mouth of the Caterpillar is provided with a pair of strong jaws, fitted to eat leaves; and the digestive organs are adapted for this kind of food.

On the contrary, the mouth of the butterfly is suctorial; it has a long proboscis, beautifully adapted to suck the nectar from flowers, but which would be quite useless, and, indeed, only an embarrassment to the larva. The digestive organs also are adapted for the assimilation, not of leaves, but of honey. Now it is evident that if the mouth-parts of the larva were gradually metamorphosed into those of the perfect insect, through a number of small changes, the insect would in the mean time be unable to feed, and liable to perish of starvation in the midst of plenty.

On the contrary, in the Orthoptera, and, as a general rule, among those insects in which the changes are gradual, the mouth of the so-called larva resembles that of the perfect insect, and the principal difference is in the presence of wings.

Similar considerations throw much light on the nature of the chrysalis or pupa state—that remarkable period of death-like quiescence which is one of the most striking characteristics of insect-metamorphosis. The comparative quiescence of the pupa is mainly owing to the rapidity of the changes going on in it.

In the chrysalis of a butterfly, for instance, not only, as has been already mentioned, are the mouth and digestive organs undergoing change, but the same is the case with the muscles. The powerful ones which move the wings are in process of formation; and even if they were in a condition favourable to motion, still the nervous system, by which the movements are set on foot and regulated, is also in a state of such rapid change that it could scarcely act.

The conclusions, then, which I think we may draw from the preceding and other considerations, are:—

1st. That the occurrence of metamorphoses arises from the immaturity of the condition in which some animals quit the egg.

2nd. That the form of the larva in insects, whenever it departs from the original vermiform type, depends in great measure on the conditions in which it lives. The external

forces acting upon it are different from those which affect the mature form: and thus changes are produced in the young which have reference to its immediate wants, rather than to its final form.

3rd. That metamorphoses may therefore be divided into two kinds, developmental and adaptational.

4th. The apparent abruptness of the changes which insects undergo arises in great measure from the hardness of their skin, which permits no gradual alteration of form, and which is itself necessary in order to afford sufficient support to the muscles.

5th. The immobility of the pupa or chrysalis depends on the rapidity of the changes going on in it.

6th. Although the majority of insects go through three well-marked stages after leaving the egg, still a large number arrive at maturity through a somewhat indefinite number of slight changes.

7th. When the external organs arrive at this final form before the organs of reproduction are matured, these changes are known as metamorphoses; when, on the contrary, the organs of reproduction are functionally perfect before the external organs, or when the creature has the power of budding, then the phenomenon is known as alternation of generations.

Insects present every gradation, from simple growth to alternation of generations.

8th. Thus, then, it appears probable that this remarkable phenomenon may have arisen from the simple circumstance that certain animals leave the egg at a very early stage of development, and that the external forces acting on the young are different from those which affect the mature form.

9th. The dimorphism thus produced differs in many important respects from the dimorphism of the mature form which we find, for instance, in ants and bees; it would therefore be convenient to distinguish it by a different name; and I have ventured to suggest the terms Dieidism and Polyeidism.

The same considerations explain the remarkable fact that in alternation of generations the reproduction is agamic in the one form. This is because impregnation requires the perfection both of external and internal organs; and if the phenomenon arises, as has just been suggested, from the fact that the internal organs arrive at maturity before the external ones, impregnation cannot take place, and reproduction will only result in those species which have the power of agamic multiplication.

REVISION OF THE FOSSIL HYMENOPTERA OF NORTH AMERICA. *I. Crabronidæ and Nyssonidæ.* By *A. S. Packard, Jr., M. D.* From the Proceedings of the Entomological Society. Philadelphia, 1866-67. pp. 167. 8vo.

This work treats of the classification of a large group of the fossorial or digging wasps. It contains descriptions of nearly all the genera and species known to inhabit North America. The species, as well as the genera of the digging wasps, are difficult to identify; but with the detailed descriptions of the genera here given, and the synoptical table of the species, the work of identification has been rendered comparatively easy. The names of species not seen by the author are added, so that it gives a complete list of all the known species, which amount to two hundred and seven, comprised in twenty-five genera, of which one new genus and fifty-eight new species are described. The family characters are discussed at length, and there are a few introductory pages devoted to the general classification of the group, their zoölogical characters, and geographical distribution.

NATURAL HISTORY MISCELLANY.

BOTANY.

HERBARIUM FOR SALE.—The collection of the Swiss botanist, the late M. Gay, is now offered for sale at the Jardin des Plantes, in Paris. This collection is of inestimable value, and embraces the whole European Flora. The author has worked upon it with rare patience and fidelity, adding to the description and analysis of each plant a complete list of the works in which it has been described; it contains ninety thousand different specimens. Dr. Henri de Saussure, from whom this information is derived, believes the Herbarium to be placed at the low price of 30,000 francs. Propositions from those wishing to purchase would be gladly entertained. Parties may address (post-paid) Dr. HENRI DE SAUSSURE, *Genthod, près Genève, Suisse.*

A FERN NEW TO OUR FLORA.—I enclose a specimen of a fern found in July, in shaded rocks at Berlin Falls, N. H., which I judge to be *Aspidium fragrans* Sw. (Gray's Manual, p. 598). As this fern is mentioned as occurring only in Wisconsin or high northward, the locality is perhaps new and worth noting. It occurs in the crevices of a perpendicular cliff a little below the falls, on the east side of the river; this cliff is plainly visible from the other bank. It is somewhat remarkable that the plant has not been before detected in so frequented a locality.

I found *Aspidium aculeatum* in a place called "the Gulch," about four miles from Gorham village; but this I believe has previously been found in the mountains. This gulch is an interesting place, where ice remains during the summer, and I regret that I had not time to explore it thoroughly.

I was engaged chiefly in looking for lichens, and I found, at Berlin Falls, an interesting plant, *Biatora lucida*, which is probably new to the White Mountain region. This pretty lichen is quite common on stones in walls in this vicinity (New Bedford). Professor Tuckerman, to whom I communicated it, at first pronounced it Arctic; but on seeing specimens, confirmed my determination. *Verrucaria margacea*, which was found by Mr. Tuckerman last season in the White Mountains, I found this summer at Clyde River Falls, Vermont, near Lake Memphremagog. At the base of "Owl's Head," on this lake, there is a cliff, the face of which is covered with *Placodium elegans* in large patches, giving it a very lively appearance. This lichen, I be-

lieve, does not usually occur so far from the coast."—H. WILLEY, *New Bedford, Mass.*

Mr. H. Mann, to whom we referred the specimen, says, "The fern (*Aspidium fragrans* Sw.) which Mr. H. Willey sends, is from quite a new, and therefore interesting locality, bringing it for the first time within the borders of New England. I believe it has not been found before on this side of the Saguenay River (where it is quite common), three hundred miles farther north."

A THORNLESS FORM OF THE HONEY LOCUST TREE.—I have been for the last three months watching a cluster of four Honey Locust trees on my farm that have no thorns. I thought that probably the thorns had been broken off by a large flood we had last September, and that new wood that might grow this spring would have thorns the same as others. There is now a fine growth of new wood, but no thorns on it. It is new to me, and others that I have had see them. Is it something unusual, or are they sometimes thornless?—J. HUGHES HUNT, *Harrison Junction, Ohio.*

A very obscure form without thorns, which by some is supposed to be a new species, has been known to exist in the Western States.—EDS.

MONSTROUS ROSES.—There is a small rose-bush in this village which bears flowers called "very double." Every summer, some of the blossoms send up a column or continuation of the receptacle from the middle of the flower. This column, after running up straight for half an inch, branches off and bears buds, which develop into small roses later than the first rose below. These "rosettes," or little roses if you like better, are as perfect as any flowers in the bush. In one instance, I counted seven little roses growing from the centre of a single flower. Another plant, in the same yard, this year produced a monstrosity a little different from the one above mentioned. The cup was very shallow and of thin texture. The points of the calyx were more leaf-like than common, one of the sepals having five leaflets, another four, another three, another two, and the other only one. Inside this calyx or whorl of leaves were plenty of petals, a few stamens, but the pistils were united into a column about half an inch long, nearly as large as the stem below the flower. This column had small prickles on two sides, and towards the top were some petals, colored on one edge, and green on the other, with fringes imitating leaflets on the green edge. At the top of the column appear five leaves, with stipules and leaflets in perfect condition. These are examples going to prove that "the blossom is a sort of branch, and its

parts leaves," and "that the receptacle of a flower is of the nature of the stem." See Gray's Botanical Text-Book, p. 230. — W. J. Beal, *Union Springs, N. Y.*

Identification of Lichens by a Chemical Test. — The Rev. W. A. Leighton continues his series of papers on this subject in the "Annals." He has lately given a notice of the Abbé Cœman's essay on the *Cladoniæ* of the herbarium of the great lichenologist, Acharius, and the results of the application to his own herbarium of a chemical test, as a means of deciphering species of Lichens. The reaction, which is found so useful, is that of hydrate of potash, which in certain cases produces a yellow color, whilst in others there is no reaction, or only a slight fuscescence. In no case, says Mr. Leighton, is the reaction of greater utility than in the difficult tribe of *Cladoniæ*, that *crux* of lichenologists, where its application enables us, with admirable precision and exactness, to determine the various species, to redistribute the confounded species, and to refer to their proper systematic places the innumerable varieties and forms which may resemble each other in external character. — *Quarterly Journal of Science, London.*

ZOÖLOGY.

The Bittern. — I notice in your August issue a letter from Mr. Endicott, in which he rather questions the accuracy of my account of the habits of the American Bittern (*Botaurus lentiginosus*), page 405, Ornithology of New England.

I am perfectly familiar with the meadows which Mr. Endicott refers to, have lived for eleven years within two or three miles of them, and have hunted them times innumerable. I never saw more than two Bitterns there in the area of a hundred acres, and doubt if any other person ever did. They seem to be most numerous in that locality in September, about the time of Snipe-shooting, and doubtless are then on the passage from the north. So I do not think it strange that Mr. Endicott has never met with many of the nests. But we cannot establish the habits of a species from individual cases, we must *generalize*.

The Bittern, as a general thing, in New England, judging from the observation of the majority of my friends and correspondents, and my own, oftener nests in bushes than on the ground, and in some localities it gathers in communities, scattered and detached if you will, but still communities, not of course extensive heronries, such as we see among the Night Herons and others, but still heronries.

Almost every nest that I ever saw or heard of was built in low

bushes or scrubby alders, usually overhanging the water. Sometimes a nest is found placed on the ground, or rather in a tussock of grass, but in such instances the meadow or swamp is comparatively dry, and not subject to inundations.

We cannot be too deliberate in forming conclusions on the habits of any animal, and our decisions must be made from numerous observations. What would Mr. Endicott say if I should affirm that the Dusky Duck (*Anas obscura*) — which is notoriously a ground nester — builds in high trees? yet Mr. George A. Boardman found one with her nest full of eggs in such a position; or that the Chipping Sparrow (*Spizella socialis*) nests in bushes? I have known it to; or that the Ruffed Grouse (*Bonasa umbellus*) lays in deserted crow's nests? I have heard of three instances; or that the Towhe Bunting (*Pipilo erythrophthalmus*) nests in low trees? it has been found to do so at Toronto. He would say, and so would any one, that I should not judge from one or two occurrences. — E. A. Samuels, *Boston*.

Eggs of the Indigo Bird. — Dr. T. W. Brewer, in the Naturalist for May, doubted that any spotted eggs of the Indigo Bird (*Cyanospiza cyanea*) have yet been found. I have several specimens in my own collection, and have heard of others being found marked, decidedly, with spots of reddish brown. The following extract from a letter recently received from Mr. L. E. Ricksecker, of Nazareth, Pa., will furnish an instance: "I found a few days since the nest of an Indigo Bird, with four eggs, which are sprinkled with fine dots of pale-red, particularly at the greater end, where they form a circle. Being puzzled at first, I thought it might be a species new to me, whereupon I took my gun and shot the female as she was leaving the nest. She proves to be an Indigo Bird. I looked into your book to compare the eggs with your description, when I found that I had before sent you some specimens marked in a similar manner. I think the present set is rather more sprinkled than any I ever found." — E. A. Samuels, *Boston*.

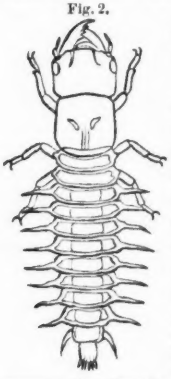
A Snake-like Caterpillar. — The most extraordinary instance of imitation I ever met with [on the Amazon] was that of a very large caterpillar, which stretched itself from amidst the foliage of a tree which I was one day examining, and startled me by its resemblance to a small snake. The first three segments behind the head were dilatable at the will of the insect, and had on each side a large black pupilated spot, which resembled the eye of the reptile; it was a poisonous or viperine species mimicked, and not an innocuous or columbine snake; this was proved by the imitation of keeled scales on the crown, which was produced by the recumbent feet, as the caterpillar

threw itself backward. The Rev. Joseph Greene, to whom I gave a description, supposes the insect to have belonged to the family *Notodontidæ*, many of which have the habit of thus bending themselves. I carried off the caterpillar, and alarmed every one in the village where I was then living, to whom I showed it. It unfortunately died before reaching the adult form.—H. W. Bates, *Linnæan Transactions*, 1862, *p.* 509.

The Horned Corydalus.—One of the largest and most formidable looking, though perfectly harmless, insects we have, is the *Corydalus cornutus*. Its large size, its broad net-veined wings and slow-stupid flight, and aquatic habits, besides many other characteristics, place it very low in the scale of insect life. Insects like this were characteristic of the Coal Period, probably breeding in the marshes and fens of Carboniferous times. It is probable that the *Sialidæ*, the family to which this insect belongs, were much more numerous in those early ages of the world's history than now, as there are wide gaps between the genera, which, were the geological record complete, we could undoubtedly fill up.

We do not yet know how many eggs are laid by the parent, or their form and size. Those of *Sialis*, an allied genus, are cylindrical, terminating at the top in a sudden point, and are attached, side by side, to plants with the greatest regularity, according to Westwood.

Fig. 2.



The larva (Fig. 2) is broad and flattened, with a pair of long, thick respiratory filaments attached to the side of each ring of the abdomen, and the body ends in a pair of legs with strong claws, which the artist has not represented in our figure. It is very fierce and active in its habits, moving over the bottom of pools, and preying on other insects, which it seizes in its powerful jaws. When of full size, it leaves the stream or pool in which it has been living, and makes an earthen cell in the bank, in which the inactive pupa undergoes the rest of its transformations. Our figure (Fig. 1, from Sanborn) of the perfect insect represents the female. In the male, the jaws are nearly as long as the antennæ, and much like them in form, being very slender.

Breeding Place of the Pelican.—In your August number appears a statement of Mr. Beal in regard to the White Pelican captured in Cayuga county, in which he copies the following extract from Professor Baird's account of the bird, in reference to its breeding habits:

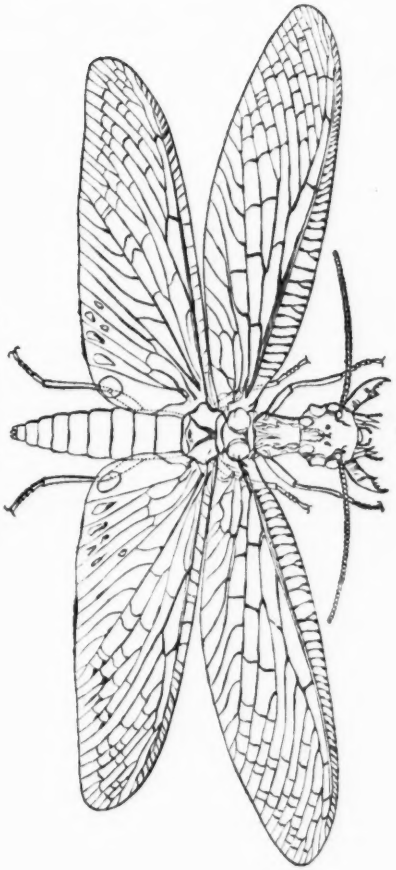


Fig. 1.

THE HORNED CORYDALUS.

"This species breeds in the fur countries, generally selecting inaccessible places in the neighborhood of waterfalls." From the above it it would seem that this bird only breeds in the countries far to the north. Now this bird breeds abundantly on the sand-bars opposite New Found Harbor, in Indian River, Florida. They lay their eggs about the middle of May on the bare sand, making no nest whatsoever. — CHARLES H. NAUMAN, *Lancaster, Pa.*

GENERIC AND SPECIFIC NAMES. — The scientific name of an animal or plant consists of two names, the *generic* and *specific*, which are given in Latin, as being, by universal consent, the most convenient medium between naturalists of different nations. Thus the scientific name of the Lion, is *Felis leo* Linn. *Felis* is the name of the genus, and *leo* is the name of the species. Linn. stands for *Linnæus*, being either the founder of the entire name, or the first one to describe the species scientifically. So also with the name *Helix albolabris* Say. Mr. Say was the first author to describe our common White-lipped Snail belonging to the genus *Helix*, and species *albolabris*.

ANALOGY AND HOMOLOGY. — Analogy is a resemblance in function between parts differing anatomically, and constructed on wholly different types. Thus the wing of the butterfly is *analogous* to the wing of a bird. In this sense must be understood the comparison made by Oken, between the pupa, or chrysalis, of an insect, and a crustacean, such as the Shrimp. The resemblance is vague, but yet sufficiently apparent to many to enable the two things to be thus compared.

The term *Homology* indicates an identity between the structure of certain parts, though the functions they perform may be quite different. Thus the arm of man and a bird's wing are said to be *homologous*, since their anatomical structure is fundamentally the same, though their uses are so different.

THE AQUARIUM. — In the matter of cementing aquaria, I have had considerable experience. I have always found white lead of any kind bad. I sent to England and paid a good price for a "secret" cement of one of the leading dealers, but found it useless, as it contained white lead or litharge. The best cement is applied *hot*. Marine glue, when it can be got, would answer capitally; but I have found a mixture of pitch, tallow, and umber melted and poured on good. I prefer to cover the corners and bottom with glass, and use an iron frame and bottom. Thus we have a strong and light-looking affair, which can be scrubbed with sand internally, as is sometimes desirable. By far the best aquaria I ever saw were made by the well-known bookseller, C. E. Hammett, of Newport, R. I. — A. M. EDWARDS, *New York.*

TEACHING OF NATURAL SCIENCE IN PUBLIC SCHOOLS.—In a paper read before the British Association, Rev. W. Farrar "expressed his conviction of the necessity and desirability of extensive education in physical science." Dr. Hooker "considered chemistry as too rigid a study for a young boy to commence with, and thought botany and zoölogy should be the first studies." Professor Tyndall "had often witnessed the deep interest boys took in the study of physics, when properly opened to them. The habit of verification by experiment, and the consciousness of a power of prediction, were most important characters to implant in the mind; but this could only be done by a true and philosophic study."

METHOD OF OBTAINING A NEW QUEEN BEE FROM WORKER-GRUBS.—Mr. Tegetmeier has described a practical application of Shirach's discovery respecting the power of bees to raise a new queen from a neuter or worker grub, by means of which the contents of old hives can be taken without destroying the bees or sacrificing any brood:—

"The plan consists in driving out the queen, and about half the bees in the spring, and establishing them as a new swarm, when the bees remaining in the old hive have to raise a new queen from a worker grub. From the time required to accomplish this, it follows that no egg can be laid for about three weeks; by this time the workers, proceeding from eggs laid by the old queen, will have been hatched out, and the cells filled with honey, when the whole of the bees are to be driven out, and the honey, which will be found perfectly free from brood, retained for use."—*Proceedings of the Entomological Society of London.*

NOVEL WAY OF SHOOTING EAGLES.—Hunters find it a very easy matter to shoot the Bald Eagles, which are occasionally found in winter along the shores of Cayuga Lake. They approach the birds on horseback, to within fifteen or twenty yards, and then slide from the horse and shoot them at their leisure.—W. J. BEAL.

GEOLOGY.

ORIGIN OF LIFE ON OUR GLOBE.—With regard to the origin of life on our globe, M. Figuier does not dogmatize:—Did plants precede animals, we cannot tell, but such would appear to have been the order of creation." Our globe, he thinks, during the Cambrian and Silurian periods, was not yet mature enough for the existence of the higher organisms. "A pale sun struggled to penetrate the dense atmosphere of the primitive world, and yielded a dim and imperfect light to the first created beings as they left the hand of the Creator, organisms often rudimentary, but at other times sufficiently advanced to indicate a progress towards most perfect creations." The absence of organisms more advanced in the zoölogical scale than were the Trilobites, is no proof that more highly organized animals did not exist on the globe during the Cambro-Silurian period. Those who

think the Darwinian theory approximates to the truth, and especially those who hold the "complete" theory, will of course believe, that animals, classed as high among the Vertebrata as the Trilobites and Cephalopoda of Lower Silurian rocks are among the Annulosa and Mollusca, existed at that time in regions of the globe from which the ocean, perhaps, forever excludes the inquiring palæontologist from verifying his conjectures. The discovery of the Eozoon Canadense in the Laurentian rocks, and the existence of beds of limestone in the same system, seem to confirm the views of those who regard the whole of the sedimentary rocks, from the Silurian and Cambrian upwards to the latest Tertiary beds, as including but a partial and fragmentary record of the past life of the globe, — impressions of the last-formed links of the great chain of organic life on our planet, — a few of the last chapters in the book of "Ancient Life." — *Quarterly Journal of Science, London.*

MICROSCOPY.

Preparation of Snails' Tongues. — I present a plan devised many years ago, for such small forms as *Littorina* and the like, whose lingual ribbons are extremely tender, and difficult to see as well as handle. I use a rather strong solution of caustic potassa, the strength of which I cannot exactly specify, as it must vary with the species under manipulation, some having ribbons of such strength that they will bear the very strongest solution, while others will be injured by immersion in a comparatively weak liquid. Into this solution in a test tube or other convenient vessel, plunge the whole animal; in the case of the smaller creatures, shell and all. The specimen may be fresh, or preserved in alcohol, but on the former the potassa will act most vigorously. I have found that one good way is to let the animal stand in the shell until it dies and begins to decompose, when it can readily be removed, and falls in pieces. The lingual ribbon, as a general thing, is not easily decomposed. Now either set the potassa solution, with the animal in it, aside for some days, or boil it at once. You will then find that almost everything dissolves and becomes "soap," except the shell and operculum, a few shreds of muscular fibre, and the prized lingual ribbon. Frequent washing with fresh water now removes all the alkali, and leaves the teeth clean and in perfect order. It can then be mounted in any preservative fluid which is miscible with water, and is best removed to alcohol to be kept until it is mounted. To mount it, remove it from the spirit, and without drying plunge it in pure spirits of turpentine, in which it should be boiled for a short time to drive off some of the alcohol. It can now

be mounted in Canada balsam, when it shows all its beauties in a remarkable manner, and, at the same time, shows its effects on polarized light. I would say, that the potassa cleans the shell and operculum beautifully. — A. M. EDWARDS, *New York.*

THE MOVEMENTS OF THE DIATOMACEÆ. — The movements of the Diatomaceæ still continue to puzzle microscopists, and various explanations of this phenomenon have been advanced. Professor Schultze has carefully studied a number of species, *Pleurosigma angulatum*, *Pleurosigma fasciola*, *Nitschia sigmoides*, *Surirella bifrons*, and others, making various experiments and observations upon them. He is led from these researches to conclude that a glutinous organic substance, which is concerned in rapid movement, is spread over the external surface of the Diatomaceæ. It is by this protoplasmic sheath that the *Bacillariæ* become adherent to one another. Professor Schultze does not consider that this view affects the question of the animal or plant nature of diatoms. He considers that they must be left with some other unicellular beings, as of "uncertain kingdom," until we know more of what constitutes the boundary, if there be any, between plants and animals. — *Quarterly Journal of Microscopical Science.*

ANSWERS TO CORRESPONDENTS.

J. T. M., Grand Isle, Vt. — The land snails sent for identification are as follows: The "largest, No. 1," is *Helix concava* Say. The "horn-colored, No. 2," is *Helix chersina* Say. The "small reflected lipped, No. 3," is *Helix minuta* Say. The "light-colored conical-shaped, No. 4," is *Pupa pentodon* Say. The late fall months will be found a very favorable time for collecting, as the leaves, having fallen, no longer obstruct the light, and the snails can be easily detected by turning up the damp layers in hard-wood growths.

D. S. C., Rockport, Ill. — "Essay on Classification," by Professor Agassiz, was published separately in London; Longmans & Co., 1859. You can undoubtedly obtain it by ordering of any prominent bookseller in New York. The cheapest form of cabinet for geological specimens is an upright case of shelves, like a bookcase. The shelves to be inclined, or to have separate steps on each shelf. For a conchological case, make a set of shallow drawers, 18x24 inches, and from two to five inches deep. For exhibition, nothing is better than a horizontal show-case, though this takes up a great deal of room.

E. L. M., New York. — Besides the works on Entomology already mentioned in the NATURALIST, you need the works on American

Entomology, published by the Smithsonian Institution, Washington, D. C. Send for its list of works for January, 1866, with the prices attached. We intend hereafter to publish in the NATURALIST an extended list of the most important works on Insects.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. — The Sixteenth Annual Meeting was held at Burlington, Vermont, commencing on Wednesday, August 21, and continuing until Monday night, August 26, 1867.

In September, 1847, the "Association of American Geologists and Naturalists" resolved itself into the "American Association for the Advancement of Science." The new organization held its first meeting at Philadelphia, September, 1848. The objects of this Association are the holding of annual and migratory meetings, to promote intercourse between those who are cultivating science in different parts of the country, and to give impulse, system, facility, and wider usefulness to the labors of scientific men.

About seventy-five members from various parts of the country were in attendance during the five days' session at Burlington, and many interesting papers were read and freely discussed during the meeting.

The Association held its meetings in the rooms of the City Hall, the Court House, and the vestry of the Third Congregational Church, under the auspices of the Local Committee. Each morning there was a general meeting for business, and then the members adjourned to SECTION A, — *Mathematics and Physics;* or to SECTION B, — *Natural History and Geology,* as their tastes inclined.

On Friday evening, the President, Professor J. S. NEWBERRY, of Columbia College, New York, gave an address on *Modern Scientific Investigation — its Methods and Tendencies.* His address applied to the whole range of the sciences. It was comprehensive, profound, and ably written, and gave great satisfaction to the members present. This address will be published in full in the next number of the NATURALIST.

On Saturday, after a short session in the morning, the Association and their friends accepted the invitation of the Champlain Transportation Company, and made an excursion to the Au Sable Chasm, in Keeseville, New York, a singular and very beautiful chasm in the Potsdam rocks, through which the Au Sable River makes its way to the Lake.

In our next we shall endeavor to give abstracts of the various papers read before the NATURAL HISTORY SECTION, only having space in this number for their titles.

FIRST DAY.

The Distribution of Precious Metals in the United States. By Col. CHAS. WHITTLESEY.

SECOND DAY.

The Geological Relations of the Mastodon and Fossil Elephant of North America. By Prof. JAMES HALL.

Considerations drawn from the Study of the Orthoptera of North America. By SAMUEL H. SCUDDER.

Traces of Ancient Glaciers in the White Mountains. By G. L. VOSE.

The Origin of the so-called Lignilites or Epsomites. By Prof. O. C. MARSH.

The Geographical Distribution of the Sediments and the Fossils of the Hamilton, Portage, and Chemung groups of New York. By Prof. JAMES HALL.

The Distribution of Limnæa megasoma and cognate genera. By L. E. CHITTENDEN.

THIRD DAY.

Tellurium a Metal. By Prof. L. Bradley.

Upon some remarkable Fossil Fishes obtained by Rev. H. Herzer from the Devonian Rocks at Delaware, Ohio. By Prof. J. S. NEWBERRY.

The Fossil Insects of North America. By S. H. SCUDDER.

The Winooski Marbles of Colchester, Vt. By Prof. C. H. HITCHCOCK.

The Zoological affinities of the Tubulate Corals. By Prof. A. E. VERRILL.

The Coal Measures of Illinois. By Prof. A. H. WORTHEN.

New Points in the Geology of Nova Scotia and New Brunswick. By Prof. J. W. DAWSON.

FOURTH DAY.

On some New Fossil Sponges from the Lower Silurian. By Prof. O. C. MARSH.

On the occurrence of Fossil Sponges in the successive groups of the Palæozoic Series. By Prof. JAMES HALL.

The American Beaver. By LEWIS H. MORGAN.

The Distortion and Metamorphosis of Pebbles in Conglomerates. By C. H. HITCHCOCK.

FIFTH DAY.

On some Fossil Reptiles and Fishes from the Carboniferous Strata of Ohio, Kentucky, and Illinois. By Prof. J. S. NEWBERRY.

Cotta's Law of the Earth's Development. By R. W. RAYMOND.

On Mountain Masses of Iron Ore in the United States. By Col. CHARLES WHITTLESEY.

On the Lower Silurian Brown Hematite Beds of America. By B. S. LYMAN.

Explanations of the Geological Map of Maine. By Prof. C. H. HITCHCOCK.

On the Geographical Distribution of Radiates on the West Coast of America. By Prof. A. E. VERRILL.

Considerations relating to the Climate of the Glacial Epoch in North America. By Prof. EDWARD HUNGERFORD.

Depression of the Sea during the Glacial Period. By Col. CHAS. WHITTLESEY.

Ripton Sea Beaches. By Prof. EDWARD HUNGERFORD.

On the Cretaceous and Tertiary Flora of North America. By Prof. J. S. NEWBERRY.

On certain Effects produced upon Fossils by Weathering. By Prof. O. C. MARSH.

Geology of Vermont. By Prof. C. H. HITCHCOCK.

The Insect Fauna of the summit of Mount Washington as compared with that of Labrador. By Dr. A. S. PACKARD, Jr.

Remarks on the Ichthyological Fauna of Lake Champlain. By F. W. PUTNAM.

The Embryology of Libellula (Diplax?), with notes on the Morphology of Insects, and the classification of the Neuroptera. By Dr. A. S. PACKARD, jr.

On the Flowering of Plants. By JAMES HYATT.

The following Resolution was proposed by Prof. O. C. MARSH, of Yale College, —

Resolved, That the chair appoint a commission of nine members to examine the Linnæan rules of Zoological Nomenclature by the light of the suggestions and examples of recent writers, and to prepare a code of laws and recommendations in conformity with the best modern usage, to be submitted to the Association at the next annual meeting; the committee to have authority to fill vacancies and increase their number to twelve, if deemed advisable.

This Resolution was unanimously adopted, and the chair appointed the following committee: — Prof. J. D. DANA, of Yale College; Prof. JEFFRIES WYMAN, of Harvard University; Prof. S. F. BAIRD, of the Smithsonian Institution; Prof. JOSEPH LEIDY, of the Philadelphia Academy of Natural Science; Prof. J. S. NEWBERRY, of Columbia College; Prof. J. W. DAWSON, of McGill College, Montreal; Dr. WILLIAM STIMPSON, of the Chicago Academy of Science; S. H. SCUDDER, of the Boston Society of Natural History; and F. W. PUTNAM, of the Essex Institute.

Dr. HENRY WHEATLAND, Secretary of the Essex Institute, offered a resolution, which was unanimously adopted, tendering the thanks of the Association to GEORGE PEABODY, Esq., for his munificent donations, amounting to over four million of dollars, for the increase of science and education in the United States.

The President was requested by the Association to forward a copy of the resolution to Mr. Peabody.

After the adjournment of the meeting on Monday night, the members met at the house of Dr. WM. C. HICKOK, and passed the few last hours of their stay in Burlington most pleasantly.

On the following day a number of the members accepted the invitation of W. H. H. BINGHAM, Esq., to visit Mt. Mansfield, where they were most cordially entertained.

The next meeting will be held at Chicago, commencing on the first Wednesday of August, 1868.

The following are the officers for the next meeting: —

President, Dr. B. A. GOULD, Cambridge. *Vice President*, Col. CHAS. WHITTLESEY, Cleveland, Ohio. *Permanent Secretary*, Prof. JOSEPH LOVERING, Cambridge. *General Secretary*, Prof. A. P. ROCKWELL, New Haven. *Treasurer*, Dr. A. L. ELWYN, Philadelphia.

The Association were invited to hold the meeting of 1869 in this city (Salem), and should they accept, as we earnestly hope they will, we know they will be most cordially welcomed by our citizens.

BOSTON SOCIETY OF NATURAL HISTORY. *March* 20, 1867. — Mr. A. L. Fleury, of New York, read an essay entitled: "Rocks in Nature and in the Arts," treating of the physical and chemical properties of

quartz, and the theories proposed to account for its origin. Observing that in nature quartz-rock is often dissolved in water by the formation and subsequent decomposition of sulphide of silicum, either with or without alkaline agency, he showed how we might follow the path thus indicated, and produce, artificially, a liquid hydrate of silica.

The Secretary read a paper by Col. Whittlesey, of Cleveland, on the weapons and military character of the Race of the Mounds. The author brought to notice the curious fact, that while extensive fortifications built by the Mound race remain scattered over the plains of Ohio, no weapons formed exclusively for warfare have yet been discovered, nor are there any indications that the defences have ever been attacked. He concluded that the weapons were probably made of wood, and that the fortifications were abandoned on the approach of the foe. He also remarked that while in Europe ethnological writers distinguish the progress of mechanical arts among men as the ages of Stone, of Bronze, and of Iron, in the Western States the ancient inhabitants did not follow this order of progress, but rather retrograded. He believed that the European age of Bronze corresponded to the age of Copper in this country, to which the age of Stone has *succeeded*, and that to this age the Indians of the present day belonged.

April 4, 1867. — Mr. James G. Swan presented a paper on the Meteorology of Cape Flattery, Washington Territory, the result of personal observation of the thermometer and rain gauge for three consecutive years.

Dr. Andrew Garratt exhibited a bony mass taken from the interior of the heart of a right whale; it was attached by two knoblike projections to the base of the valves, and hung free in the cavity of the heart. On examination, Dr. J. C. White had found it to be composed of an external shell of fibrous tissue, dense and glistening like parchment, and an interior spongy mass of a brownish and somewhat fatty substance; it seemed to be a coagulum of fibrine, or possibly a pathological growth from the valves of the heart.

At the last meeting of the Section of Entomology — records of which were read at this time — Mr. S. H. Scudder exhibited drawings and specimens of fossil insects from the Devonian rocks of New Brunswick. Six tolerably well-preserved specimens had been obtained by Mr. C. F. Hartt, all belonging to the Neuroptera, or lace-winged flies, but differing greatly from any now living. They were the earliest traces of insect life yet discovered, the oldest insects previously known having been found in the Carboniferous strata.

Mr. Scudder exhibited a photograph of another fossil wing, found in the Carboniferous rocks of Cape Breton. It was simple in structure, of gigantic size, and probably belonged to the May flies.

Some notes of a visit to the Pinjrapal, or animal hospital of Bombay, were read by Mr. W. T. Brigham. A space of six or seven acres in the heart of the city was enclosed, and divided into wards, for the reception of sick and helpless animals; cattle, deer, dogs, goats, monkeys, and even tortoises, had all their separate abodes; fish, too, rescued from impending death by the pious Hindoos, whose religion forbids the destruction of animal life, swam unmolested in their proper tanks. No surgical aid seemed to be given, but the animals were well fed and cared for by a large staff of attendants or nurses. There are several of these establishments in India, supported by the donations of wealthy Hindoos.

April 18, 1867. — Dr. Jeffries Wyman gave an account of an excursion he had recently made to the St. John's river, Florida, for the purpose of examining the Indian antiquities of that region. His attention was especially given to the shell mounds. These mounds are of two kinds; those on the sea-coast, made up of *marine* shells, as at Fernandina and St. John's bluffs, and those found inland, which are composed entirely of *fresh-water* shells. Twenty-eight of the latter, situated between Pilatka and Salt Creek, were examined. Although they have not hitherto been attributed to the aborigines, there is abundant evidence that Indians lived upon them from their commencement up to the time of their completion: pottery, bones of edible animals, such as deer, wild turkeys, ducks, soft-shelled turtles and catfish were scattered throughout their whole extent. Beds of charcoal were found at various depths resting on calcined shells, and near them were fragments of burnt bones. Ornaments and flint implements were very rare, but a few miles above Pilatka, a worked flint was discovered in the sand under a shell mound eight feet high. The shells were principally univalves of the genera *Ampullaria* and *Paludina*, with some fresh-water mussels, *Unionidæ*.

The age of these mounds was not determined, but the occasional occurrence of live oaks five feet in diameter proved that the mounds had not been materially increased since the advent of the white man, more than three centuries ago.

There was a marked variety in the fragments of pottery belonging to different localities. Specimens from the upper portion of the river were slightly ornamented by square and regular indentations; those from the neighborhood of Lake Munroe were marked by complicated figures, traced on the clay with a pointed instrument, while near the

mouth of the river these patterns became still more elaborate, and in almost every instance the clay, forming the earthen ware, was mixed with sand. This was rarely the case in specimens obtained from the upper waters.

ACADEMY OF SCIENCES. *Chicago, June* 11, 1867.—The Secretary presented a paper entitled "Contributions to Comparative Geography," by Dr. Herman Haig, accompanied by a letter from the author, in which he stated that he had submitted the same to Humboldt shortly before his death, but that the paper had been returned unopened. He now desired to lay it before the Academy in the hope that his discoveries would meet with public recognition through their means. On motion, the paper was referred to a committee of three, consisting of Dr. Rauch, Professor Stimpson, and Professor Daniels.

A paper was presented from Charles A. White, M. D., and O. H. St. John, entitled, "Descriptions of New Subcarboniferous and Coal Measure Fossils, collected upon the Geological Survey of Iowa, together with a notice of new generic characters observed in the species of brachiopods."

July 9.—The Secretary read abstracts of a couple of papers by Professor T. H. Safford, one on the motion of the solar system in space, and the other relative to observations on nebulæ with the large reflectors of the Dearborn Observatory. The papers were referred to a special committee, composed of Dr. Blaney and the Secretary.

Dr. Blaney then made some remarks on the spectral analysis, the manner of using it, and the purposes for which it was employed.

The presiding officer spoke in reference to the continued discoveries of silver in Colorado.

Dr. Blaney reported that he had assayed some chips taken from the bottom of a well in Canada, dug down three feet deep in the rock, and got out $9 in silver. The well had been dug under spiritual guidance.

Remarks were made by the presiding officer and Dr. Blaney, relative to salt deposits in the Western Territories, after which the meeting adjourned.

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA. *March* 19, 1867. Prof. E. D. Cope presented to the Academy a young specimen of the Whale, known as the Bahia Finner, procured near Bahia, Brazil; the length was twenty-one feet. It was shown to belong to the genus *Megaptera* Gray, the Hump-back Whale of sailors.

Dr. Leidy exhibited a number of plates of a forthcoming work on the extinct mammals of Nebraska and Dacota, among which was

one representing an almost complete skull of an animal, which he characterized under the name of *Agriochœrus latifrons*.

Prof. Ennis inquired whether remains of the Hippopotamus had been found in this country. Dr. Leidy replied that no evidence existed of the animal, though Mr. J. A. Conrad had at one time a tooth which he considered to have belonged to the Hippopotamus.

April 9, 1867.—Professor H. C. Wood, jr., presented a paper entitled, "Description of New Species of Texan Myriapoda."

A paper was read from Isaac Lea, LL. D., on two new minerals (*Lesleyite* and *Patersonite*), from Chester county, Pennsylvania.

Professor Ennis spoke of the "Geological Changes resulting from the rise and fall of the Ocean level;" also upon the "Natural History of Man."

Professor Cope exhibited several vertebræ of a new species of Gavial (*Thoracosaurus brevispinus* Cope), from the cretaceous marl of Burlington county, New Jersey.

April 23, 1867.—Mr. J. Cassin read a paper entitled, "A third Study of the Icteridæ—Sub-family Icterinæ.

BOOKS RECEIVED.

Petroleum in North America. By Professor C. H. Hitchcock. (Extracted from the Geological Magazine, January, 1867.) 8vo, pp. 3.

Some account of Barettia, a new and remarkable Fossil Shell from the Hippurite Limestone of Jamaica. By S. P. Woodward. Reprinted from the Geologist, 1862. Plate 1, 2. 8vo, pp. 8.

On some Points in the Structure of the Xiphosura, having reference to their relationship with the Eurypteridæ. By Henry Woodward. (From the Quarterly Journal of the Geological Society for February, 1867.) Plate 1, 2. 8vo, pp. 9.

Some Observations on the Zoantharia Rugosa. By Gustave Lindström, Ph.D. One plate. (Extracted from the Geological Magazine, Aug. and Sept., 1866.) 8vo, pp. 14.

Quarterly Journal of Science. April, 1867. London.

Results of Meteorological Observations made at Brunswick, Maine, between 1807 *and* 1869. By Parker Cleaveland, LL. D. Reduced and discussed by Charles A. Schott. From the Smithsonian Contributions. 1867.

The American Bee Journal and Gazette. Vol. II. No. 13, July, August, 1867.

The Chemical News and Journal of Physical Science. Vol. I. No. 1, 2. July, August, 1867.

Prize Essay on Medical and Vital Statistics. By F. B. Hough, M. D. Albany, 1867. 8vo, pp. 37.

Notes on Wilson's Readers. By S. S. Haldeman. 1866. 8vo, pp. 24.

State Geological Survey of Iowa. Preliminary Notice of New Genera and Species of Fossils. By C. A. White, M. D., State Geologist, and O. H. St. John, Assistant. 8vo, pp. 2.

A Third Study of the Icteridæ. By John Cassin. 1867. 8vo, pp. 74.

On Colonies of Plants observed near Philadelphia. By Aubrey H. Smith. 1867. 8vo, pp. 10.

Ambas Americanas, Revista de Educacion, bibliografia i Agricultura, bajo los Auspicios de D. F. Sarmienta. Volumen I. Nueva York, 1867. 8vo.

Chemistry of the Farm and the Sea, and other familiar Chemical Essays. By J. R. Nichols, M. D. Boston, 1867.